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‘Religious facts’ and History of Sciences :

Example of a Fruitful Interaction in the French School of the 21st Century¹

Marc Moyon²

INTRODUCTION

While religion, the rule of God, the opposition between faith and reason are regularly barriers to science and its practice at least until the 17th century, the situation of the early 21st century is another nature. The ignorance of the new generations in matters of religion is such that they seem not to be able to understand the world around them and the events that shape it. To read Ferdinand Buisson (1841-1932) who is close to Jules Ferry (1832-1877), in a speech in 1905 about the creation of a religious education in accordance with the secularism characteristic of the school of the Third Republic (1870-1940), we understand the difficulty involved in our school throughout the 20th century until today :

And then we will say that, for the education of a child who has become a man, it is good that he was in turn placed in contact with the inflamed verses of the prophets of Israel, philosophers and Greek poets, that he lived, somehow, in Athens and in Rome, that he has known and felt something of the Antique city. To him, it would be good know and feel the most beautiful pages of the Gospel as those of Marcus-Aurelius, whether laminated, as Michelet said, all the Bibles of humanity, he finally makes cross, not with prevention and critically, but with a warm sympathy, all forms of civilization which succeeded. It will fall for Middle Ages [...] He will understand the greatness of the Church, and then the greatness of the work of philosophers who attacked the Church. [...] (Buisson 1912, p. 241-242)

The problem that we wish to raise in this paper³ is related to *religious education* that would partially thought through the history of sciences. It is therefore not religious education in the strict sense, the history of religions or sciences of religion but rather a consideration on the way in which epistemology and the history of science may be used to teach religious facts. Our main objective is relatively straightforward: to try to familiarize oneself as much as possible with the universe mythological, ritual practices and even the sacred texts that have contributed to the genesis and development of sciences. Often unknown to the public a teacher or a trainer (in initial and in-service teacher training) faces, these elements prove to be important in an interdisciplinary education. Nevertheless, we already inform our readers that we will consider here only references to the two monotheistic religions: Christianity and Islam. This is obviously not an ideological choice but rather a reflection of our own knowledge as an historian of medieval mathematics written in Arabic and Latin. We have to add that this

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³ We presented a preliminary version of this article in the seminar *Materie Prime. The discipline scolastiche the e formazione del passato e cittadino*, University of Turin (30 March 2012). We would like to thank the organizers of this event and the participants for their questions and comments that helped us to improve our arguments.

perspective is also an explicit request of many teachers probably because the understanding of Islam is important in French events.

First of all, we would like to define what we mean by "teaching religious facts" in trying to describe as precisely as possible the discussions that took place in France around the need for culture and education, which becomes a necessity with the Debray's report in 2002. This necessity goes along with a well thought teacher training (initial and in-service) in French republican and secular school, the heir of Jules Ferry's School. In a second step, we shall show, using examples, how the history of sciences can contribute to teaching religious facts in schools or teacher training in respect of the secular school providing both the knowledge necessary to the religious culture of any individual, and the scientific knowledge (and know-how) in question.

"TEACHING RELIGIOUS FACT": A DEBATED ISSUE IN FRANCE

The purpose of this article is not to contribute to the history of the teaching of religion in France, this issue is well done in (Carpentier 2004). Nevertheless, it seems important to us to review some elements of this history to clarify the context in which our thinking was developed. In September 1989, the Chief Education Officer and historian Philippe Joutard gave Lionel Jospin, Minister of Education, his *Rapport de la Mission de Réflexion sur l'Enseignement de l'Histoire, la Géographie, les Sciences Sociales* (Joutard 1989) in which he stressed the need to remedy the lack of religious culture found among students: "Ignorance of religion may prevent contemporary minds from having access to major works of our artistic, literary and philosophical heritage." (Joutard 1989) This report is the starting point for a new way of thinking which will gradually integrate "religious facts" in the curricula of schools (all levels), not by a new isolated material, but by treating transversely and especially in strict secularism. The teacher must adopt a distanced, historicized position which informs the student without judgment.

The finding of loss of cultural identity of students in French primary and secondary schools was even more relevant a decade later when, in 2002, Régis Debray delivered its report dealing with the teaching of religious facts in secular school (Debray 2002) to Jack Lang, Minister of Education. The main goal of teaching religious facts in respect of secularism is confirmed. It is certainly not to open a spiritual dimension in the classroom; it is not the role of a teacher in primary school (3-10 years), secondary (11-18 years) or at university level. A teacher must enable pupils and students to have a sufficient background to understand the complexity of the world around them, to lift the veil on the history of past and present civilizations, giving them knowledge to decode art, literature, history or scientific practices. The main goal of this religious instruction is to acquire a taste for what is different, of looking at the world through a prism hitherto unknown. As stated by Régis Debray, one of the most important purpose is to "open young minds to the full range of behaviors and cultures in order to help them discover what kind of world they live in, and what collective heritage they are accountable." (Debray 2002, p. 20)

Our position is therefore objective towards religions historicizing the great classical texts (the *Bible*, the *Quran* for example) without "criticizing" religions. The important thing to do is to insert religion in its political, economical, social and cultural context providing an answer to citizens' demands about knowing the others. This demand is all the more important than cultural and cultural diversities are extensive. In this context, studying

religious facts is not only a matter for history, geography, literature, philosophy or art teachers. Various other disciplines must be concerned to complete the approaches and construct the idea of interdisciplinarity (Nouailhat 2004). Scientific disciplines, especially mathematics, physics, chemistry, biology and geology are important. This is probably the price to pay for secular education such as France has known for over a century to be saved. Thus, the history of sciences, or more precisely the introduction of a historical perspective in the Science teaching, brings its contribution. Moreover, it is one of the ideas defended by the Debray's Report in the following excerpt :

It is important to focus the ambition on teaching contents, through a more reasoned convergence between existing subjects and especially through a better preparation of teachers. The latter need to be encouraged, reassured and disinhibited, thus need to be better prepared intellectually and professionally to answer a very sensitive matter, since it refers to the deepest identity of pupils and their families. A better seconding competence on a subject not unreasonably deemed difficult or complicated (socially more "hot" than science or art history) should help ease tensions, dispassionate and even, if I dare say trivialize the subject, without stripping it, quite the contrary, from its inherent dignity. (Debray 2002, p. 35)

THE RELIGIOUS FACT THROUGH THE PRISM OF THE HISTORY OF SCIENCE: TWO EXAMPLES.

The relationship between Science and Society or Science and Religion are recurring themes in the study of academic researches, and especially among science philosophers and historians. Even with the creation of the European Institute of Religious Sciences in Paris (in 2002) following the Debray's report, this issue is still rarely dealt with in Primary and Secondary Education. At best, the attention is drawn to the major societal debates on medical ethics or creationist theories, for example. But for the history of sciences, it is too often limited to the emblematic figures of Giordano Bruno or Galileo to crystallize the tensions and conflicts that kept Science and Religion. Here we would like to introduce two examples to facilitate the acquisition by students (from primary school to university) or teachers in continuing education of a scholarly knowledge on religions. Both contribute to a historicizing (and not a sacred) of holy texts and a rational approach to religions as facts of civilization⁴.

Mathematics and the Islamic Inheritance Law.

Before explaining a specific example of the relationship between Mathematics and Islam, it is necessary to expose the general spirit in which Science in Islamic countries developed. It grew from the legacy of the Ancients (Greek and Indian in particular) and from a significant movement of translation from the late 8th century. The Islamic Golden Age is traditionally dated between the mid-8th and the 13th century until their decline due to, in particular, Science written in Persian (East) and Latin or Hebrew (West). If we think about the relationship between Science and Religion in Islam, it is necessary to keep several things in mind. First, scientific practices were profane nature. Scientists from Islamic countries wrote their books in Arabic, the language of scientific

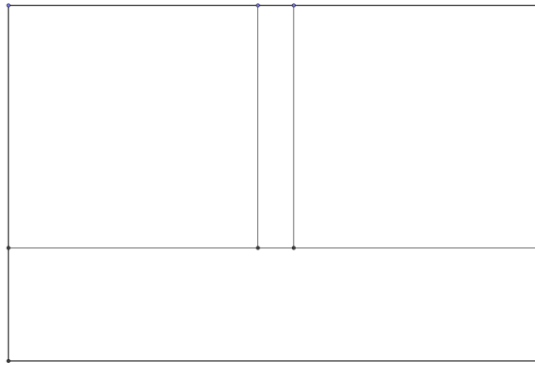
⁴ Editorial constraints that are ours here do not allow us to detail the pedagogical devices that can be implemented in the classroom. We refer, for example, to (Moyon 2013).

communication. Then there is no miracle in science, there are human activities. In Islam, there is no dogmatic opposition about the need for men to discover the laws of nature, from the moment it does not undermine the primacy of God in the knowledge of these laws. Several typical examples can be given here as the calculation of the hours of the five daily prayers, the calculation of the direction of prayer (*qibla*) or the determination of the beginning and the end of lunar months (Djebbar 2001, Djebbar 2010). All these scientific developments which brought originality in Science (mathematical geography, astronomy and trigonometry for example) are directly related to the daily organisation of the Islamic society respecting the sacred text, the *Quran*. They can not be neglected in teacher training or classroom where the question of the utility of science is often asked. They gave a precise answer and an objective lighting on religious practices in Islamic countries that can be considered, along with other social and economical factors, such as *impetus* to scientific research.

In many mathematics Islamic books, both from the East and the West, we find a geometry chapter dealing with the division of plane figures. Problems are often shared between land owners or beneficiaries with real constraints like a path or a water source, etc. To understand properly, let's consider a problem enounced by a lawyer-mathematician of the 11th century, Ibn Tâhir al-Baghdâdî, the author of an arithmetics textbook untitled *at-Takmila fi l-hisâb* [The completion of Arithmetics] as well as an epistle on the measurement. In the last chapter of the latter, he proposes to solve the following generic problem:

And if we want to fit out a path in a land with right angles, or equal sides, or unequal its length or its width and that the land be divided between three people, or four people, or five people or whatever [the number of people], the method for it is to multiply the side on which we want to fit out the width of the path by the number of shares by which the land is divided, for example shares of the sons, of the daughters, of the two parents and of the husband. We subtract from it the width of the path and the rest is the divisor. Then, we multiply the area of the path by the number of heirs, minus the part of one who had charge of the path. The result of the division is the length of the path. And when we know the length and the width of the path, the rest of the land can be shared between them according to <the rules of> sharing of God the Almighty. And if the division is between two sons and one daughter, it will be between five parts. If it is between two daughters and one son, it will be between four parts. And everything that reaches to you in this chapter <resolves> it according to this method and it will be its solution. And this is the figure for it⁵. [Ibn Tâhir al-Baghdâdî 1985, p. 372-373]

⁵ For a mathematical analysis of this problem, see (Moyon 2011, Moyon 2012).



In this kind of problem, knowledge of mathematics is not strictly sufficient. Indeed, the knowledge of Islamic Inheritance Law, *ʿilm al-Farâʿid*, is essential. Thus, in accordance with *Quran*, several mathematical problems of sharing lands (whether arithmetic or geometric) correspond to the administration of the city. It is not necessary here to detail the science of inheritance in Islam which is complex and whose meanders are probably irrelevant for our purposes in this paper (Laabid 2002). However, in this context, several excerpts from the *Quran* or *hadiths* can be studied in relation to geometric problems that mathematicians and/or lawyers have resolved. Here, for example, verses 11 and 12 of Sura 4 - *an-nisa'* [Women] - set a number of legal requirements for distribution of inheritance:

11. Allah decrees a will for the benefit of your children; the male gets twice the share of the female. If the inheritors are only women, more than two, they get two-thirds of what is bequeathed. If only one daughter is left, she gets one-half. The parents of the deceased get one-sixth of the inheritance each, if the deceased has left any children. If he left no children, and his parents are the only inheritors, the mother gets one-third. If he has siblings, then the mother gets one-sixth. All this, after fulfilling any will the deceased has left, and after paying off all debts. When it comes to your parents and your children, you do not know which of them is really the best to you and the most beneficial. This is Allah's law. Allah is Omniscient, Most Wise.

12. You get half of what your wives leave behind, if they had no children. If they had children, you get one-fourth of what they leave. All this, after fulfilling any will they had left, and after paying off all debts. They get one-fourth of what you leave behind, if you had no children. If you had children, they get one-eighth of what you bequeath. All this, after fulfilling any will you had left, and after paying off all debts. If the deceased man or woman was a loner, and leaves two siblings, male or female, each of them gets one-sixth of the inheritance. If there are more siblings, then they equally share one-third of the inheritance. All this, after fulfilling any will, and after paying off all debts, so that no one is hurt. This is a will decreed by Allah. Allah is Omniscient, Clement.

By extension, it would be useful to return to the text which marks the birth of algebra as the science or art of solving equations. It is the al-Khwârizmî's *Mukhtasar*, written in Bagdad between 813 and 833 under the Umayyad caliphate of al-Ma'mûn. Besides the strictly mathematical content of the book (solving equations of degree less than or equal to two), two main reasons make this text a staple for teacher training or even in

classroom (14-18 years). First, many problems dealing with sharing according to the Islamic inheritance law as above are introduced in the arithmetic conception. For example, here is two of these problems extracted from the chapter *On Legacies*: "A woman dies, leaving her daughter, her mother, and her husband, and bequeaths to some one as much as the share of her mother, and to another as much as one-ninth of her entire capital." (Rosen 1831, p. 99); "A man dies, and leaves four sons, and bequeaths to some person as much as the share of one of his sons; and to another, one-fourth of what remains after the deduction of the above share from one-third." (Rosen 1831, p. 104). Then, this work of al-Khwârizmî is known in Andalus (the Iberian Peninsula under Muslim rule) and is translated into Latin twice (at least) in the 12th century when Christian Europe appropriates the knowledge and practices of Islamic countries. The willingness of two translators, Robert of Chester and Gerard of Cremona, is to fill the shortage of knowledge of Christian Europe at the time of the birth of the Mediaeval university. In both Latin versions mentioned, the part about the science of inheritance is not translated because it is too specific in its relationship with Islamic law. Indeed, at that time in Europe, it is the birthright prevailing. That's why these problems are not necessary for the Latin Christian Europe

The rainbow from Greek Antiquity to Latin Middle Age.

The history of the scientific study of the rainbow, intrinsically linked to that of light, is interesting not only from an epistemological point of view to question Science but also for the complex relationships it maintains with theology that does not cease to be questioned (Blay 1995, Maitte 1981, Maitte 2005). Since Antiquity, this genetic history feeds the founding texts with several works of Greek Philosophers (such as Pythagoras, Plato and Aristotle) to rationalize myths. The rainbow is an irrefutable evidence of a link between two of the three cosmic regions : Heaven and Earth. The rainbow is the trace of a messenger between Earth and Heaven when the sun is combined with the rain. This messenger is the God with the fastest wings and feet: she is the goddess Iris who carries Zeus' s orders to the gods and the omens to men.

Reading the *Bible* is important in this diachronic study in particular for two key passages: the *Genesis* (the creation of Lights, the Flood) on the one hand and the *Apocalypse* on the other hand. Indeed the rainbow appears to Noah at the end of the Flood, this is a sign of the alliance between God and men. As in Greek mythology, the rainbow connects Earth and Heaven, God and men. Let read [Genesis, 9.12-9.17] :

And God said, this is the sign of the agreement which I make between me and you and every living thing with you, for all future generations. I will put my bow in the cloud and it will be for a sign of the agreement between me and the earth. And whenever I make a cloud come over the earth, the bow will be seen in the cloud, And I will keep in mind the agreement between me and you and every living thing; and never again will there be a great flow of waters causing destruction to all flesh.

And the bow will be in the cloud, and looking on it, I will keep in mind the eternal agreement between God and every living thing on the earth. And God said to Noah, This is the sign of the agreement which I have made between me and all flesh on the earth.

In John's *Apocalypse*, the rainbow appears twice [Apocalypse 4 and 10]. In particular, in this excerpt on the Judgment Day [Apocalypse 4-10]:

After these things I <John> looked and saw a door opened in heaven, and the first voice that I heard, like a trumpet speaking with me, was one saying, "Come up here, and I will show you the things which must happen after this." Immediately I was in the Spirit. Behold, there was a throne set in heaven, and one sitting on the throne that looked like a jasper stone and a sardius. There was a rainbow around the throne, like an emerald to look at. (...)

I saw a mighty angel coming down out of the sky, clothed with a cloud. A rainbow was on his head. His face was like the sun, and his feet like pillars of fire. He had in his hand a little open book. He set his right foot on the sea, and his left on the land. He cried with a loud voice, as a lion roars. When he cried, the seven thunders uttered their voices. When the seven thunders sounded, I was about to write; but I heard a voice from the sky saying, "Seal up the things which the seven thunders said, and don't write them."

From the 9th century, contributions from Islamic scientists (al-Kindî, Ibn Sahl and Ibn al-Haytham in particular) were essential. All know the mythologic interpretation and the Biblical references. But, as they claimed the existence of light as a physical reality endowed with properties (it is able to ignite) and they established from 10th/11th century what *experimental method* was. Then a full theory of the rainbow (explanation of its shape and colors) was given at the beginning of the 14th century by the Persian Kamâl ad-Dîn al-Fârizî⁶. The context of a secular science is here fundamental. Christian Europe, the theater of a strong religious power with an omnipotent clergy, prevented such advances until at least the 13th century: as a symbol of God, the "light" can not be considered as a physical object of study and the status of the Experience continues to be questioned. Effects on the study of rainbow are immediate. For example, imprisoned by the use of sacred texts, medieval Christians give a preference to a symbolic representation in three colors (Pastoureau 2007): Blue (the flood, the sky), red (the end of the world, hell) and green (median color, human, calming, refreshing color of hope and deliverance but fate and the precariousness of things). But the passage of John's *Apocalypse* quoted above leads sometimes to see seven colors in the rainbow. For Gottfried of Viterbo from the 12th century, those seven colors are like the seven Christian sacraments, like the seven gifts of the Holy Spirit and the Virgin who unites Earth to Heaven. We must reconcile faith and reason in the sense that Science must be propaedeutic to religion. A place is gradually made to experience that, even for the best craftsmen, remains intellectual. More and more men of science are opposed to theologians wanting to separate Philosophy from Theology because they do not have the same purpose. It is necessary to accept several theses in Philosophy which can not be accepted in Theology. It is in this way of thinking, in the 14th century, that Dietrich of Freiberg, a Master of the Faculty of Theology in Paris, gave, for the first time in the Latin world and without contact with the Muslim East, a complete theory of the rainbow.

CONCLUSION

In this paper dealing with the teaching of religious facts, we have shown several effects of the introduction of an historical perspective in the scientific teaching. Indeed, it is clear that our first purpose (in the respect of the

⁶ For a pedagogical use of al-Fârizî's works, see (Djebbar 2009, p. 55-63)

French secularism) is obviously to transmit both historical and scientific knowledge and in any case to develop religious beliefs. We also showed how the reading of sacred and founding texts may go with a scientific study to understand Science and its status in history better. Finally, the history of science can shed light on the tensions between the dogma defined by the sacred texts (whatever the religion) and men whose designs can disrupt civic societies. The two communities we dealt with, which are led on behalf of monotheism, have evolved into what they are today and it is essential to understand these changes in their own context without judging them. If you do not want to sink into darkness, our students must have the key to this understanding.

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